

**UNDERSTORY PLANTS AS INDICATORS OF HOST TREES OF THE
WOUNDED TREE BEETLE, *NOSODENDRON CALIFORNICUM*,
IN NORTHERN IDAHO (COLEOPTERA: NOSODENDRIDAE)¹**

D. L. KULHAVY,² J. W. SCHWANDT,³ AND S. D. HOBBS⁴

College of Forestry, Wildlife and Range Sciences,
University of Idaho, Moscow 83843

The wounded tree beetle, *Nosodendron californicum* Horn, occurs in the northwestern United States on slime fluxes of white fir, *Abies concolor* (Gord. and Glend.) Lindl., grand fir, *A. grandis* (Douglas) Lindl., Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, and in California on *A. concolor* and California black oak, *Quercus kelloggii* Newb. (Sokoloff, 1959, 1964; Hatch, 1961; Arnett, 1968; Zack et al., 1979). The habitat of the wounded tree beetle in northern Idaho is slime fluxes of tree wounds of grand fir infected with the Indian paint fungus, *Echinodontium tinctorium* (Ell. and Ev.) Ell. and Ev. The wounded tree beetles are apparently attracted to the slime flux odor and are a component of the slime flux ecosystem (Sokoloff, 1959, 1964). In Idaho, wounded tree beetles are found in *A. grandis*/*Pachistima myrsinites* and *Thuja plicata*/*P. myrsinites* habitat types (h.t.) (Osborne and Kulhavy, 1975) as described by Daubenmire and Daubenmire (1968).

Adults and larvae are found singly or in groups on frost cracks, basal stem wounds, or in ooze puddles at the base of tree wounds. The adults and larvae overwinter under loose bark or in duff at the base of host trees. Colonization of host trees is thought to occur from July through August and the beetles are sedentary during the months of September through March (Osborne and Kulhavy, 1975).

In this paper, plant species groups were evaluated during the 1974 and 1975 field seasons as possible indicators of suitable host trees of *N. californicum* in the *T. plicata*/*P. myrsinites* h.t. of northern Idaho.

Study Areas

Two 50-hectare areas were established in the *T. plicata*/*P. myrsinites* h.t. southwest of Elk River, Clearwater County, Idaho. Study area A, located 9 km SW of Elk River on the Tired Wolf and the Butterfield drainages, is in the xeric portion of the *T. plicata*/*P. myrsinites* h.t. There have been repeated entries into the stand to remove high value western white pine, *Pinus monticola* Douglas. The residual stand consists of over-mature grand fir with pockets of *T. plicata* Donn understory. Many of the grand fir contain *E. tinctorium* decay and have basal logging wound scars and frost cracks.

Table 1. Structure of a 2×2 chi-square contingency table used in Table 2.

(a) Trees having both beetles and associated plant groups	(b) Trees having no beetles, but having indicator plant groups
(c) Trees having beetles but no indicator plant groups	(d) Trees having neither indicator plants nor beetles

ab interaction is calculated as $[a/(a + b)] \times 100$; the ac interaction is calculated as $[a/(a + c)] \times 100$.

Slime fluxes and ooze puddles from the slime flux runoff have formed at the base of the wounded grand fir and in logging wounds. The crown canopy is not continuous, resulting in a mosaic of understory vegetation. The average elevation is 920 m with a south to southeast aspect.

Area B, located 7 km SSE of Elk River in the mesic portion of the *T. plicata*/*P. myrsinites* h.t., borders a fork of Oviatt Creek. The area is a cool air drainage with *T. plicata* as the major understory tree species. The overstory is dominated by over-mature grand fir, western white pine, and remnant western larch (*Larix occidentalis* Nutt.), with Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, on the drier slopes. The area has no recent indications of logging or fire, and the tree crowns form a canopy-like cover of the forest floor. The majority of the dominant and codominant grand fir have *E. tinctorium* decay. The average elevation is 895 m with a west to northwest slope.

Methods

In Areas A and B, all dominant and codominant grand fir with oozing wounds ($n = 60$ and $n = 40$, respectively) were selected for study. A vegetation species list, including all perennial shrubs, forbs, and graminoids, was compiled on a $1/50$ circular hectare ($1/20$ acre) plot centered at each tree. On each sample tree, the numbers and location of any life stages of *N. californicum* were recorded. To determine if any groups of plants were indicators of the presence of *N. californicum*, the data were analyzed using a 2×2 contingency table and chi-square computer program developed by Miller (1974). The 2×2 contingency table segregates the beetle-plant group associations into four categories (Table 1). The ab interaction is the conditional probability of finding a particular plant group given the presence of the beetle. This gives the percentage of trees having beetles and also having indicator plant groups. The ac interaction is the conditional probability of finding the beetles given the presence of the indicator plant groups.

Results

Utilizing the 2×2 contingency tables and chi-square tests, two 3-plant groups and two 4-plant groups in Area A; and three 3-plant groups, one 4-

Table 2. Indicator plant groups for *Nosodendron californicum* host trees in the *Thuja plicata*/*Pachistima myrsinites* habitat type, northern Idaho, 1974–1975.

Indicator plant group	Contingency table cell ¹				Chi-square	Probability	
	a	b	c	d		ab	ac
Area A							
<i>Hieracium albiflorum</i> Hook., <i>Vaccinium membranaceum</i> Douglas, <i>Tiarella trifoliata</i> L.	12	14	1	33	13.76**** ²	46%	92%
<i>H. albiflorum</i> , <i>V.</i> <i>membranaceum</i> , <i>Pachistima</i> <i>myrsinites</i> (Pursh) Raf.	11	15	1	33	11.92***	42%	92%
<i>H. albiflorum</i> , <i>P. myrsinites</i> , <i>T.</i> <i>trifoliata</i> , <i>Thermopsis</i> <i>montana</i> Nutt.	11	15	1	33	11.92***	42%	92%
<i>H. albiflorum</i> , <i>T. trifoliata</i> , <i>T.</i> <i>montana</i> , <i>Galium triflorum</i> Michx.	11	15	1	33	11.92***	42%	92%
Area B							
<i>Polystichum munitum</i> (Kaulf.) Presl, <i>V. membranaceum</i> , <i>Lonicera ciliosa</i> (Pursh) DC.	17	8	1	14	11.88***	68%	94%
<i>P. munitum</i> , <i>V.</i> <i>membranaceum</i> , <i>Disporum</i> <i>trachycarpum</i> (Wats.) Benth. and Hook.	15	10	0	15	11.95***	60%	100%
<i>P. munitum</i> , <i>V.</i> <i>membranaceum</i> , <i>L. ciliosa</i> , <i>Rubus parviflorus</i> Nutt.	15	10	0	15	11.95***	60%	100%
<i>P. munitum</i> , <i>V.</i> <i>membranaceum</i> , <i>Goodyera</i> <i>oblongifolia</i> Raf.	15	10	1	14	9.00**	60%	94%
<i>P. munitum</i> , <i>V.</i> <i>membranaceum</i> , and either <i>D. trachycarpum</i> or <i>L. ciliosa</i> (or both <i>D. trachycarpum</i> and <i>L. ciliosa</i>)	19	1	6	14	18.03***	76%	95%

¹ a, both *N. californicum* and indicator plants present; b, indicator plants alone; c, *N. californicum* alone; d, neither *N. californicum* nor indicator plant groups present.
² ** $P \leq 0.01$; *** $P \leq 0.001$.

plant group, and the combination of two of the 3-plant groups in Area B indicated the presence of *N. californicum* at least 92% of the time (Table 2). The best indicator plant group in Area A, with an ab conditional probability of 46% and an ac conditional probability of 92% consisted of *Hier-*

Table 3. Common names and usual habitat of indicator plants for host *Abies grandis* of *Nosodendron californicum*, northern Idaho, 1974–1975.

Indicator plant species	Common name	Usual habitat ¹
<i>Hieracium albiflorum</i> Hook.	Hawkweed	Fairly moist slopes and open woods
<i>Vaccinium membranaceum</i> Douglas	Huckleberry	Mountain slopes
<i>Tiarella trifoliata</i> L.	False mitrewort	Damp woods
<i>Pachistima myrsinites</i> (Pursh) Raf.	Mountain lover	Midmontane
<i>Thermopsis montana</i> Nutt.	Buckbean	Widespread in Pacific Northwest
<i>Galium triflorum</i> Michx.	Bedstraw	Widespread in Pacific Northwest
<i>Goodyera oblongifolia</i> Raf.	Rattlesnake-plaintain	Dry to moist forests
<i>Lonicera ciliosa</i> (Pursh) DC.	Orange honeysuckle	Widespread native twining vine
<i>Disporium trachycarpum</i> (Wats.) Benth. and Hook.	Fairy-bell	Wooded slopes, often near streams
<i>Rubus parviflorus</i> Nutt.	Thimbleberry	Moist to dry, wooded to open areas
<i>Polystichum munitum</i> (Kaulf.) Presl	Christmas fern	Moist conifer forests, in open, or in deep shade

¹ Scientific names, common names and usual habitat from Hitchcock and Cronquist (1973).

acium albiflorum Hook. (hawkweed), *Vaccinium membranaceum* Douglas (huckleberry) and *Tiarella trifoliata* L. (false mitrewort). The best indicator plant group in Area B comprised the combination of two 3-plant groups with an ab conditional probability of 76% and an ac conditional probability of 95%. These plant groups were *Polystichum munitum* (Kaulf.) Presl (Christmas fern), *V. membranaceum*, with either *Disporium trachycarpum* (Wats.) Benth. and Hook., or *Lonicera ciliosa* (Pursh) DC. (or both *D. trachycarpum* and *L. ciliosa*) present. The common names and usual habitats of the indicator plant groups are given in Table 3.

Discussion

Our analysis indicates that we can predict the occurrence of *N. californicum* with a greater than 90 percent probability of being correct in areas where indicator plant groups are present (ac conditional probabilities, Table 2) in the *T. plicata*/*P. myrsinites* h.t. near Elk River, Idaho. However, as indicated by the ab conditional probabilities (Table 2), we cannot say that wherever the beetles occur, the indicator plants will occur. This means that

the range of *N. californicum* within the sample area exceeds that of the indicator plant groups.

The higher ab probabilities in Area B indicate considerable overlap between the ecological amplitude of *N. californicum* and the indicator plants. The canopy-like coverage of the forest floor, coupled with the high occurrence of old-growth grand fir (mean \pm SD_x = 117 years \pm 17) with *E. tinctorium* decay combine to provide macro- and microenvironmental factors necessary for the occurrence and propagation of *N. californicum*. In contrast, many of the host grand fir in Area A are colonized fortuitously in that *N. californicum* invades logging wounds. Many of these wounds will not provide suitable overwintering sites, as the preferred overwintering site is the root collar below the duff (Osborne and Kulhavy, 1975). As Area A recovers from the effects of logging and stand disturbance, the numbers of grand fir colonized by *N. californicum* should diminish.

As *N. californicum* is often cryptically concealed on its host or is present only below the duff (Osborne and Kulhavy, 1975), finding the indicator plant groups in areas of grand fir with *E. tinctorium* decay will aid in locating *N. californicum*. The plant groups from Area B indicate the preferred habitat of *N. californicum* are cool air drainages in the *T. plicata*/*P. myrsinites* h.t., while those of Area A are indicative of marginal sites for *N. californicum*.

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Footnotes

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² School of Forestry, Stephen F. Austin State University, Nacogdoches, Texas.

³ Current address: Department of Lands, Box 670, Coeur d'Alene, Idaho.

⁴ Current address: School of Forestry, Oregon State University (stationed at Medford, Oregon), Medford.